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Some Obſervations and Reaſons given for the courſe of the Herrings, and the variation in their Mean Diſtance from the Sun in different months of the year.

[See Map B, Plate V.]

JANUARY. In this month the herrings are ſuppoſed to be returning from too warm a climate and the approaching ſun, from which they retreat faſt.

FEBRUARY. The time of ſpawning now drawing nigh, the herrings, in this month paſs through the gulph ſtream, and fall on the coaſt of America, in order to depoſit their ſpawn in freſh ſhoal water.

MARCH. Now being the beginning of the time of ſpawning, the largeſt and ſtrongeſt fiſh, which perhaps are the oldeſt, ruſh up into the bays, inlets and freſh water ſtreams.

APRIL. In this month the leſſer, weaker, and perhaps younger fiſh, ruſh up even to the heads of ſmall ſtreams, as far as it is poſſible for them to get, and lay their ſpawn. Theſe are twice as numerous as the other.

MAY. Having been detained by the ſpawning ſeaſon, they are overtaken by the ſun, and nearer to it now than at any other time; they therefore haſten out of the rivers in this month, and make great way towards the North ſea.

JUNE. Now having by a rapid progreſs puſhed into a cold climate, on a chilly, icy coaſt, and the ſun beginning to draw towards the ſouth, they whirl round eaſtward.

JULY. The coldneſs of this ſea, and the ſun's declination towards the ſouth, now inclines them that way, in which they fall on the Orkneys, and the ſcoole divides.

AUGUST. The grand ſcoole being divided, now ſurround the whole iſland of Great-Britain and Ireland, and are caught on every ſide.

SEPTEMBER. Having been detained the laſt month by their obſtruction amongſt the iſlands, and being harraſſed by the fiſhermen, their mean diſtance is now the greateſt; they collect into one body and haſten to the ſouthward.

OCTOBER. Being now under great way, they leſſen their mean diſtance, and by the courſe which they ſteer, which perhaps is inclined more weſtward by the current of the trade wind, they paſs the Atlantic.

NOVEMBER. Being now more in the trade, and having approached a warmer climate, their motion is ſuppoſed to incline more weſtward.

DECEMBER. The ſun now beginning to return, they are ſuppoſed to incline more northward, to the place where we began; where they are ſuppoſed to meet their young fry.

N° XXXI.

Obſervations on a Solar and a Lunar Eclipſe, communicated to the Society by M. M. De GRAUCHAIN, *Major General of the French Squadron.*

(Tranſlated from the French.)

GENTLEMEN, Newport, 5th December, 1780.

THE ſtudy of aſtronomy having often occupied my leiſure during the peace, I could not refuſe myſelf even in the midſt of the preparations for war, an oppor-

tunity which preſented of making two important obſervations, which I have the honour of ſending you.

Eclipſes form the baſis of chronology; this may one day ſerve to fix the epocha of the independence of America, one of the moſt intereſting in the hiſtory of mankind. This is a motive to dedicate theſe obſervations to you; and I pay this reſpect with the greateſt pleaſure to an illuſtrious ſociety, whoſe members know how at the ſame time to enlighten their country by their knowledge in mathematics and philoſophy, and to ſerve them ſucceſsfully in their councils and armies.

I am, &c.

DE GRAUCHAIN, Major General of the French Squadron.

MESSIEURS,

L'ETUDE de l'aſtrononie ayant ſouvent occupé mon loiſir pendant la paix, je n'ai pu me refuſer, même au milieu de l'appareil de la guerre, a l'occaſion qui fut preſentée de faire deux obſervations importantes et j'ai l'honneur de vous les adreſſer. Les eclipſes forment la baſe de la chronologie, et celles cy pourront un jour ſervir a fixir l'epoque de l'independance de l'Amerique l'une des plus interreſſantes de l'hiſtoire du genre humain. C'eſt un motif pour vous en dedier les obſervations, meſſieurs, et je rends cet hommage avec le plus grand plaiſir a une ſocieté illuſtre dont les membres ſcavant en même temps eclaires leur patrie par leur connoiſances dans les mathematiques et dans la phiſique, et la ſervir utilement dans les conſeils et dans les armées.

Je ſuis avec reſpect, Meſſieurs,

Votre tres humble et tres obeiſſant ſerviteur,

DE GRAUCHAIN, Major general de l'eſcadre Francoiſe.

A Newport le 5 Novembre, 1780.

An

An Obſervation of an Eclipſe of the Sun on the 27th of October, 1780, at Newport in the State of Rhode-Iſland.

	Time by the Clock.			True Time.		
	h.	′	″	h.	′	″
The time that the eclipſe was perceived to begin,	9	24	32	11	0	12*
The preceding limb of the ſun at the vertical,	11	21	39	0	57	27
The upper edge of the ſun at the horizontal,		21	54		57	42
The upper horn of the moon at the horizontal,		22	3		57	51
The edge of the moon at the vertical,		22	45		58	33
The upper horn at the vertical,		23	7		58	55
The lower horn at the vertical,		23	35		59	23†
The lower horn at the horizontal,		29	31	1	5	20
The lower limb of the ſun at the horizontal,		31	2		6	51‡
The preceding limb of the ſun at the vertical,	11	37	12	1	13	1
The upper limb ditto at the horizontal,		37	59		13	48
The upper horn ☽ at the horizontal,		38	52		14	21
The limb ditto at the vertical,	not obſerved.					
The upper horn ditto at the vertical,		38	57		14	16
The lower horn ditto at the vertical,		39	19		15	8
The lower horn ditto at the horizontal,		43	38		19	8
The lower limb of the ſun at the horizontal,		45	27		21	17
The preceding limb ☉ at the vertical,	11	47	8	1	22	58
The upper edge of ditto at the horizontal,		48	17		24	7
The limb of the ☽ at the vertical,		49	0		24	50
The upper horn at the vertical,		49	5		24	55
The upper horn at the horizontal,		47	7		24	57
The lower limb of ☉ at the horizontal,		55	2		30	52
The end of the Eclipſe,	12	4	50	1	40	41
The rate of the clock,	At Noon.					
October 21,	10	35	12,8			
24,	10	29	42,0			
25,	10	27	52,3			
27,	10	24	15,8			

* When the ſun was perceived to be indented, it was about 1′ 20″ after the eclipſe began, therefore the true time of beginning was at 10h. 58′ 52″.

† Uncertain.

‡ The ſuperior limb is called the inferior, &c. as the glaſs of the quadrant inverted the objects.

The latitude of the place of obſervation on Goat-Iſland, 41° 30′ 20″ N.

An

An Obſervation of the Eclipſe of the Moon on the 11th of Nov. 1780, at Newport in the State of Rhode-Iſland.

	Time by the Clock.			True Time.		
	h.	′	″	h.	′	″
The beginning of the Eclipſe,	7	40	5	10	24	39
Immerſion of Grimaldi begins,	7	48	50	10	33	25
Ditto, ends,	7	51	25	10	36	10
Immerſion of Tycho begins,	8	0	36	10	45	12
Ditto, ends,	not obſerved.					
The ſhadow to Gallileo,	8	3	42	10	48	18
Immerſion of Copernicus begins,	8	27	54	11	12	31
Ditto, ends,	8	32	35	11	17	12
The ſhadow in the middle of Dionyſius,	8	46	55	11	31	33
The ſhadow of the Pointed Promontary,	8	55	42	11	40	21
Copernicus begins to appear,	9	17	54	12	2	34
Grimaldi - - ditto,	9	22	2	12	6	42
Copernicus wholly appears,	9	23	35	12	8	15
Grimaldi - ditto,	9	26	45	12	11	26
The Pointed Promontary appears,	9	51	12	12	35	55
Tycho wholly appears,	10	10	6	12	54	51
The end of the Eclipſe,	10	32	10	13	16	57
	At Noon.					
The rate of the Clock, November 11,	9	16	15,7			
12,	9	14	30,7			

Remarks upon the Obſervation of the Eclipſe of the Sun.

THE clock by which the time was obſerved, is a pendulum one with a verge of compenſation, made by Mr. Parthond, a celebrated clock maker at Paris. It was regulated many days before and after the obſervation by correſponding altitudes taken with a quadrant of Ramſden, having a radius of one Engliſh foot; it is a very good one and well graduated.

The ſame quadrant ſerved to obſerve the time when the horns and limbs of the moon and ſun arrived at the hori-

Eclairciſſements ſur l'obſervation de l'eclipſe de Soleil.

LA pendule dont on s'eſt ſervi pour obtenir l'heure eſt une pendule a verge de compenſation faite par M. Barthond celebre horloger de Paris, elle a eté reglée pluſieurs jours avant et apres l'obſervation par des hauteurs correſpondantes priſes avec un quart de circle de Ramſden d'un pied anglois de rayon tres bon, et tres bien diviſé.

Le même quart de cercle a ſervi pour les obſervations des paſſages des cornes et des bords du ſoleil et de la lune au fil horiſontal, et au fil vertical de la lunette qui y eſt adaptée.

L'obſervateur qui en embarquant des inſtruments d'aſtronomie n'avoit eu pour objet que de regler des montres marines, n'etoit pas auſſi bien pourvu de lunettes que de pendules et de quart de

horizontal and vertical threads of the glaſs which is fitted to the quadrant.

The obſerver who provided and ſhipped the inſtruments, had no other object in view but to rectify the clock belonging to the ſhip, which was the cauſe that he was not ſo well provided with teleſcopes as with clocks and quadrants, he was therefore obliged to make uſe of a ſimple achromatic ſea-glaſs of four feet focus, to obſerve the beginning and end of the eclipſe.

Yet he believes he can anſwer for the end of the eclipſe within about four or five ſeconds. The inſtant of time which it began is much more uncertain. The ſun was already indented when it was firſt perceived, but in order that he might eſtimate groſsly the true time of its beginning, he has eſtimated pretty nearly the diſtance of the horns, the moment when the ſun's limb was firſt perceived to be indented. By comparing the time elapſed after the end of the eclipſe to the inſtant when the diſtance of the horns of the moon were ſenſibly the ſame, hence he judged that it ſhould have been about $1' 20''$ from the true time in which the eclipſe began until the obſerved time.

At

de cercle, et il a eté obligé de ſe ſervir pour les obſervations du commencement et de la fi de l'eclipſe d'une ſimple lunette achromatic de mer de quatre pieds de foyer.

Cependant on croit pouvoir repondre de la fin de l'eclipſe a quatre ou cinq ſecondes pres; l'inſtant du commencement eſt beaucoup plus incertain; le ſoleil etoit deja conſiderablement entamé, lors qu'on s'en eſt appercu: pour conclure au moins groſſierement l'inſtant vrai du commencement de l'eclipſe, on a eſtime a peu pres quelle etoit la diſtance des cornes au moment ou on s'eſt appercû que le diſque du ſoleil etoit entamé, et vers la fin de l'eclipſe on a examiné combien il s'eſt ecoulé de tems depuis l'inſtant ou la diſtance des cornes a eté ſenſiblement la même juſqu'a la fin de l'eclipſe. C'eſt de cette maniere que l'on a jugé qu'il devoit s'etre ecoulé environ $1' 20''$ depuis l'inſtant vrai du commencement de l'eclipſe, juſqúà celui ou on s'eſt appercû, quelle etoit commencée.

On a dabord crû inutile de chercher a obſerver la grandeur de l'eclipſe avec le quart de cercle, a cauſe de la lenteur du movement des deux aſtres dans le ſens vertical, cependant a la reflexion on a penſé que les paſſages des cornes et des bords du ſoleil et de la lune au fil vertical ſeulement ſuffiroient pour donner les differences de hauteur et d'azimuth des centres des deux aſtres, et par conſequent leur difference de latitude et de longitude. On les a donc obſervès vers la fin de l'eclipſe, et en même tems on a obſervé les paſſages au fil horiſontal, mais ſans eſperer quils puſſent etre d'un grand ſecours pour calculer la diſtance des centres.

Dans la premiere obſervation le paſſage de la corne ſuperieure au fil vertical eſt un peu douteux. On penſe donc qu'il eſt a propos d'employer de preference dans le calcul de cette obſervation les paſſages du bord de la lune, et de la corne inferieure au même fil vertical. De cette maniere on connoitra immediatement les lignes N B et C O dont la premiere combinée avec les deux diametres L N et S T donnera L E; difference d'azimuth des centres des deux aſtres. On obtiendra auſſi facilement la difference apparente de hauteur S E des mêmes centres en calculant

At firſt it was thought uſeleſs to endeavour to obſerve the magnitude of the eclipſe with the quadrant, becauſe of the ſlow movement of the two planets vertically, yet upon reflection he thought that the paſſage of the horns and limb of the ſun and moon to the vertical thread only, would be ſufficient to give the differencies of the altitude and azimuth of the centers of the ſun and moon, and of courſe their difference of latitude and longitude. He then obſerved them towards the end of the eclipſe, and at the ſame time obſerved the time of their arrival at the horizontal thread, but without any expectation of their being of great ſervice to calculate the diſtance of the centers from.

In the firſt obſervation the paſſage of the upper horn to the vertical thread, is a little doubtful; at the time it was thought proper to give the preference to the paſſages of the limb and lower horn of the moon to the ſame vertical thread, in making the calculations from this obſervation; by this means we may find the lines NB and CO, the firſt of which combined with the two diameters LN and ST will give LE, the difference of azimuths and of the centers of the two planets; the apparent difference of the altitude from the ſame centers may be eaſily obtained, by calculating SF and CM, ſides of the right-angled triangles CSF and CLM, in which are known the other two ſides.

Plate III. Figure 18.

In

culant SF et CM cotes des triangles rectangles CSF et CLM dans les quels on connoit deja les deux autres cotés.

Dans la ſeconde obſervation on a obmis par diſtraction, l'inſtant du paſſage du bord de la lune au fil vertical, on ſe ſervira donc pour la calculer des paſſages des cornes au même fil les quels donneront immediatement CA et CO d'ou ſouſtrayant ST, on aura CD et CF connoiſſant ces deux lignes et le demi-diametre du ſoleil on calculera les angles CSD, CSF ſouſtrayant leur ſomme de 180°, on aura l'angle CSL partageant cet angle par la moitié on aura l'angle CSL du triangle CLS, on connoitra donc aiſement SI, coté de cetriangle et du triangle SLE calculant enfin ce dernier triangle SLE dans le quel on connoit deux angles et un côté on obtiendra LE; difference d'azumuth et SE; difference apparente de hauteur des centres des deux aſtres.

La derniere obſervation etant plus complette on pourra la calculer indifferement de l'une ou l'autre maniere. On pourra même faire uſage du paſſage au fil horiſontal pour conclure la difference de hauteur attendu que le movement des deux aſtres dans le ſens vertical commencoit a devenir moins lent lorſque cette obſervation a eté faite.

In the ſecond obſervation was omitted, by inattention, the inſtant of the arrival of the limb of the moon to the vertical thread, which however may be calculated by the arrival of the horns to the ſame thread, by which CA and CO are obtained: By ſubtracting S T from theſe, the remainder will be CD and CF, having theſe two lines and the ſemi-diameter of the ſun, the angles CSD, CSF, may be had, and ſubtracting their ſum from 180° the remainder will be the angle CSC, the half of which is the angle CSL; from the triangle CSL you may readily obtain SL, a ſide of this triangle, and of the triangle SLE; from theſe at length this laſt triangle SLE may be calculated, in which are had two angles and one ſide, from which may be obtained LE the difference of azimuth, and SE the apparent difference of altitude of the centers of the ſun and moon.

My laſt obſervation being more complete, might be calculated either from the one or the other method, and the paſſage to the horizontal thread might even be uſed to determine the difference of the altitude of the centers, as the motion of theſe planets with reſpect to the vertical, began to be quicker when this obſervation was made.

If we are deſirous to aſcertain the time of the paſſage of the upper horn of the moon to the vertical thread in the firſt obſervation, or to know in the ſecond obſervation the time of the paſſage of the limb of the moon by the ſame thread, they may eaſily be calculated by the help of the quantities already found. Perhaps it might be uſeful to make this calculation, to determine the variation which ought to have place in the poſition of the two points obſerved,

Si l'on vouloit dans la premiere obſervation veriffier l'inſtant du paſſage de la corne ſuperieure au fil vertical, ou connoitre dans la ſeconde obſervation l'inſtant du paſſage du bord de la lune au même fil on pourroit aiſement les calculer avec le ſocours des quantites deja connues. Il ſera peutetre même utile de faire ce calcul pour ſe mettre en etat de determiner la variation qui a du avoir lieu dans la poſition des deux points obſervér relativement l'un a l'autre, pendant l'eſpace de tems ecoulé entre leurs paſſages au même fil.

relatively to each other during the time elapſed between their paſſage to the ſame thread.

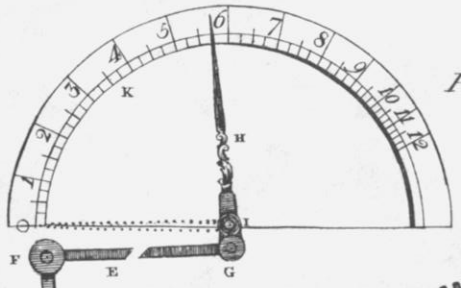
Obſervation de l'eclipſe de Lune.

ON a fait uſage dans cette obſervation de la même quart de cercle, et de la même lunette qui avoient ſervi pour l'obſervation de l'eclipſe de ſoleil. La marche de la pendule etoit cependant un peu differente parce qu'on y avoit touché.

N° XXXII.

An Account of the Tranſit of Venus over the Sun, June 3d, 1769, as obſerved at Newbury, in Maſſachuſetts; by the Rev. SAMUEL WILLIAMS, A. M.

THE tranſit of Venus over the ſun, being one of the moſt uncommon and uſeful phenomena in aſtronomy, I determined to make as careful an obſervation of it as I could. Early in May I received an invitation from *Triſtram Dalton*, Eſq. a gentleman of Newbury-Port, to obſerve it with him. He had a ſeat at Newbury, in a high elevated ſituation, very convenient for this purpoſe, at which we agreed to make the obſervation. The weather for ſeveral days had been dull and rainy, but clearing up on Tueſday evening I went early on Wedneſday to put every thing in readineſs. The regulation of our clock being an article of great importance, I was very careful to have it thoroughly examined, and well fitted up. To adjuſt it to apparent time we took correſponding altitudes of the ſun, both before and on the day of the tranſit. In theſe obſervations, it was eaſy to arrive to a pretty great exactneſs; and as they were very numerous, the going of the clock was well aſcertained by them, and found to be ſteady and regular. The teleſcope we had prepared was a reflector made by *Nairne*, magnifying about 55 times; a good inſtrument, but not fitted with a micrometer,



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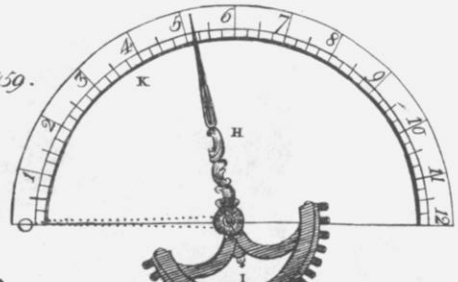

Fig. 1.

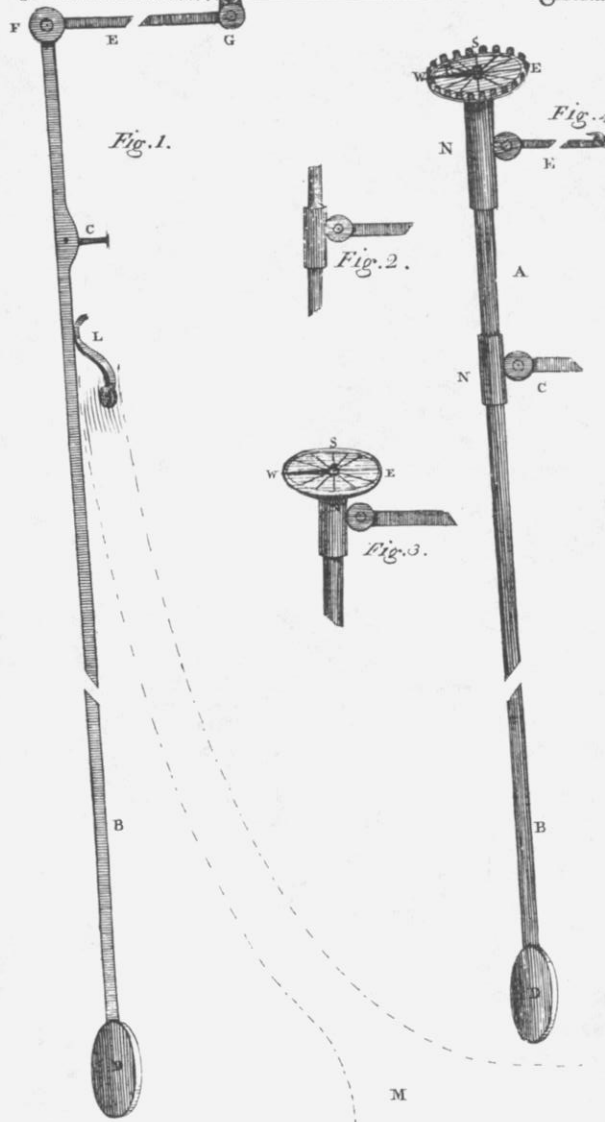

Fig. 2.

Fig. 3.

Fig. 4.

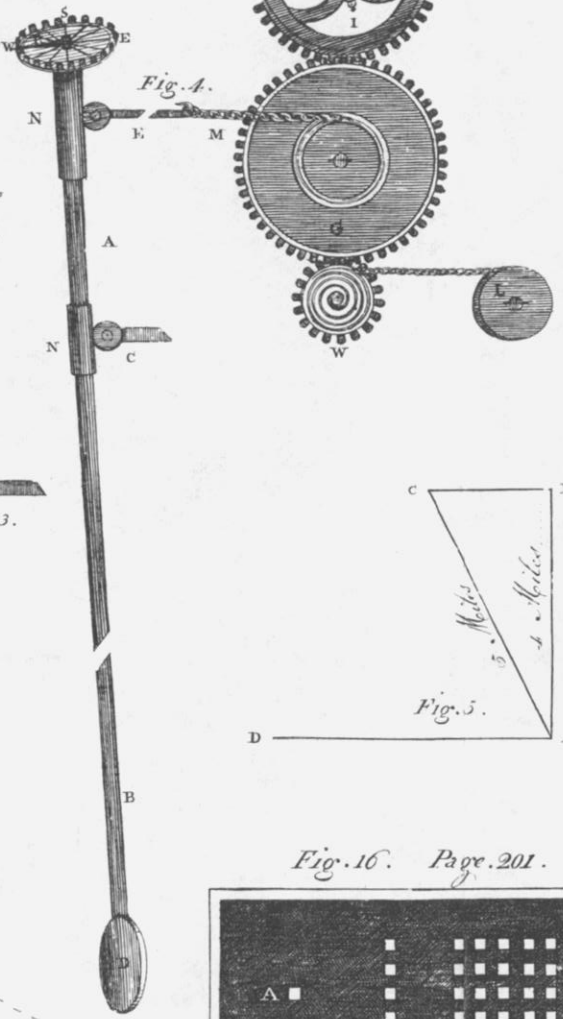

Fig. 5.

Fig. 16. Page. 201.

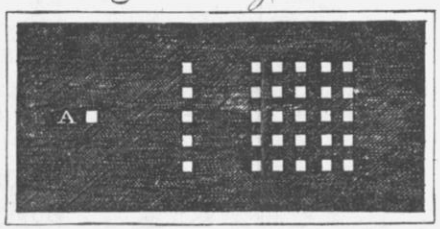

Fig. 6.

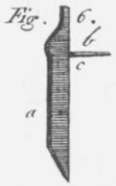

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

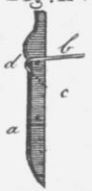

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Fig. 12.

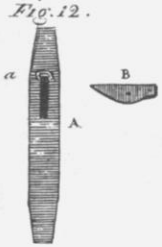


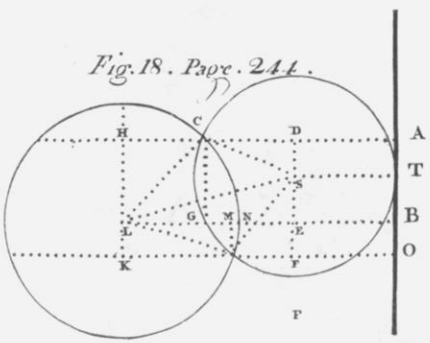
Fig. 13.

Fig. 14.

Fig. 15.

Fig. 17.

Fig. 18. Page. 244.



Jn.t Peyrard sculp.t